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ON THE EDUCATIONAL VALUE OF NATURAL SCIENCE : SOME NOTES CONDENSED AND COMPILED FROM VARIOUS SOURCES.

BY WALKER BOWMAN.

Such subjects as Botany, Zoology, Physics and Chemistry—Natural Sciences—have now taken a firm hold upon the system of education in this country as well as elsewhere. In fact, be it said to the honor of our clear-sighted and far-sighted pedagogical leaders, some of the first efforts to introduce a study of the Natural Sciences into the common school system, particularly the elementary portion of it, were made in the United States. However this may be, the importance of teaching the Natural Sciences to the rising generation is, at the present day, so universally acknowledged, that we are filled with wonder when we reflect that only a few decades ago they were looked upon by many—especially by educationists—with disdain, not being considered worthy even to appear upon a school programme. At that time the belief was general that the dead languages alone possessed a real disciplinary and educational value. The study of natural objects or of the operations of the forces of Nature could, from the standpoint of that period, lead to no good results ; and the branches dealing with such subject-matter if pursued at all in the schools, should be cultivated only by specialists, who must

of necessity have a knowledge of one or more of the Natural Sciences for the practice of their professions. But as for their being useful in developing the faculties of pupils in general—why, the mere idea was scouted. The following passage by a writer of the third decade of this century will give an insight into the state of feeling on this question : “The study of crude matter does not give the mind the proper exercise to enable it to apprehend the invisible, nay, not even to comprehend the visible. The earth and natural phenomena are much too near the pupil to give his mind nourishment. The only thing in them worth seeing is the invisible, but the mind’s eye cannot see the invisible unless it has already been trained by means of ideas. Hence, instruction in these subjects does not assist in grasping ideas, but still further blunts the mental vision.” Similar arguments are used even at the present day against an extension of nature study in the school course. But they are wide of the mark. Such a view of the study of Natural Science is as distorted and prejudiced as were the opinions of the old Greeks touching the same question. Xenophon, reflecting the attitude of the masses, says, “Such things—the movements of the heavenly bodies, their distance from the earth, etc.—will always remain a secret. Nay, more, it cannot be otherwise than displeasing to the gods, when we seek to discover what they have so carefully hidden.” The standpoint is as dogmatic in the one case as in the other.

During the present century, however, a great change in educational matters has taken place, which has resulted in breaking down the “tyranny of the dead languages,” and in establishing the value of nature studies (as well as that of historical and social studies) for training the mental faculties. The amount of Latin and Greek required for graduation and considered necessary for a liberal education, has been gradually growing less. In some places Greek has practically disappeared from the school programme, while Latin has been tolerated and retained more out

of deference to an established system and on account of its "long domination" than from a conviction of its superior claims and merits. Mathematics has maintained its position, and no doubt will always hold high rank on account of the value both of mathematical knowledge and of mathematical training. Nature studies, on the other hand, have been constantly growing in favor. From holding a most subordinate position, they have now come to compete—if such an expression be admissible—with the dead languages and mathematics as means of mental discipline. From being bundled together and being looked upon as a single subject, to be taught by a single instructor, they have come to demand and to receive separate treatment for each branch. And looking beyond the present into the future, it seems probable they will continue to grow in popularity and to occupy more and more space upon the school programme.

It is unfortunate that classical or other studies and the Natural Sciences should be, or ever should have been, in any sense arrayed against each other, and spoken of as if they were inherently antagonistic. All branches, whatsoever, of human knowledge treated in the schools are primarily to be considered merely as means to an end, as only so many different roads leading to the same goal—the training of pupils to be useful members of society. Basing our procedure upon the pedagogical principal that individuals differ in mental endowments in kind as well as in quantity, and that such differences should have due weight in deciding upon the means best adapted to develop the mental faculties, the proper course to pursue seems plain. When a pupil's bent is such that a study of the classics will best develop his powers, then Latin and Greek should undoubtedly form a large part of his mental pabulum. But when his tastes and inclinations point in some other direction, then it seems equally plain that Latin and Greek should not be forced down his throat regardless of the nausea to which they must give rise. Without substituting analogy for fact, which, as Sir Humphrey Davy has remarked, is the bane of some philosophies, we may, in this general way, compare dietaries for the body with those designed for the mind. The same general principles apply to each class. The food should be plain, not too highly seasoned and of a mixed

character. Some constitutions thrive best on a diet in which meat is prominent, others when fruit and vegetables form the staple. Similarly, some minds develop best when exercised with linguistic studies, others when directed to historical or other studies. To anyone who has thought upon the subject, it must seem perfectly clear that pupils should not be made to fit into a procrustean system. The general extension of the elective system of courses and studies is evidence that this principle is pretty well recognized amongst educationists. It is doubtful, however, if its action has anywhere been fully tested. Its application, indeed, is most restricted just where it would probably produce the best results—in elementary and secondary education. If a wider choice of studies prevailed, it can hardly be doubted that less time would be given to the classics. At all events there are not a few who hold that an everyday school ration consisting chiefly of Latin and Greek, is too highly flavored for the constitutions of most pupils. The food should be simple and natural, particularly in early life; and it is undeniable that the youthful mind best finds such food in a study of the Natural Sciences. There was a time, however, and that not so long ago, when such a proposition as that just stated would have been ridiculed. To-day it has advocates in every civilized country, and nowhere else, perhaps, such warm advocates as in the United States. It seems to be only a matter of time for this doctrine to find lodgment in the mind of every teacher, and to express itself upon every school programme. The leavening influence is working rapidly, and we may confidently look forward to the time when the whole will be leavened.

In thinking upon the comparatively short space of time in which the teaching of Natural Science has been at all general, whereby the school course has been so greatly modified and enlarged, one would naturally suppose the necessary programme changes must have often been premature and subversive. Fortunately, such has rarely been the case. The exclusion of old, and the introduction of new, material has in the main been gradual and steady, though simply irresistible. Had violent and hasty alterations been made, we might have better grounds for doubting their permanency. But it is not for a moment to be supposed that the alleged pre-

tender was permitted to quietly come in and peaceably take possession of any part of the wellnigh sacred classical and humanistic territory, that had so carefully been fenced in and guarded. The whole history of the Science invasion has been one of continual struggle and bitter controversy, a veritable "war of words." Every claim of birthright was as first denied the intruder, and her tenure of any portion of the fair Hellenic and Latin dominions was viewed in no higher light than that of squatter sovereignty. In order to drive out the interloper, every engine in the controversial armory was brought to bear and made to thunder forth anathemas both loud and deep—but all in vain. In place of retreating, the enemy has steadily advanced, though always under protest.

Of all the ordnance employed to check the progress of natural knowledge, there is no piece that has so unremittingly been kept in operation as that heavy gun, which, for the sake of brevity and convenience, we may term the "ideal" gun. It has been argued from the very first, that the ideals of mankind can not withstand the blighting influence of a study of Nature. And even at the present day, we hear the cry raised that our ideals are in danger of being submerged in the raging flood of natural knowledge and material aims. We are told that the signs of the times indicate that cataclysmal changes are just ahead of us; that in the resulting chaos of intellectual motives, we shall be unable to recognize those former lofty conceptions that directed our efforts. To ordinary minds, the surface indications of such an impending calamity are not sufficiently plain to cause a panic. As the weight of evidence is against catastrophism in the physical world, so in the moral and intellectual worlds we have no sufficient reason to expect a break in uniform development. The doctrine of evolution, which is confirmed by a study of the phenomena alike of physical, mental and moral development, speaks strongly against this ideal "war of elements, wreck of matter and crash of worlds." We may well ask, is it possible to look into the pages of history and not be convinced that the moral and intellectual level of our own times, considered from a general point of view, is far above that of any preceding age? Nothing is more certain than that the progress of the human race as a whole has

been continuous, whether we read its history in fossil or scrip.

Meantime the amount of real, natural or scientific knowledge goes on increasing, while material and utilitarian views are rapidly spreading; and yet the world continues to grow better, to become a more pleasant and profitable place to inhabit. Particularly is this true of our own country. Practical, material and utilitarian ideas are undoubtedly the springs of our action and the source of our greatness. In the eyes of other nations, "Americanism" has no other significance. For this reason we have our imitators as well as our detractors. Twenty years ago a distinguished German savant observing with sorrow the rapid growth in the Fatherland of American ideas, or the americanization of German ideals, pleaded most eloquently with his countrymen to counteract the poison of Americanism by taking larger doses of Hellenism. He went so far as to characterize the former as a veritable Neo-barbarism. It may be remarked, in passing, that it must be a potent drug to produce such effects and at such long range. On this side of the Atlantic, the American type of manhood is considered the latest and highest product of civilization.

Have the results obtained from the broadening of the educational foundations by the introduction of science teaching justified the changes made? We can unhesitatingly reply, they have, in every way, despite the fact that the full benefit therefrom has not yet been gained, and probably will not be gained for several decades to come. The reason for this will appear when we remember that the methods for imparting nature instruction are just in their infancy, are more or less in a state of transition. Scarcely two generations of teachers have labored upon this problem. No wonder, then, the methods are imperfect and in need of further development. They are at a great disadvantage in this respect, when compared with the methods for giving instruction in the dead languages. These are the product of years of work and experience. Many generations of teachers have labored upon them, refining, improving, recasting, so that they ought to be as near perfection as anything human. Moreover, the teaching force available for giving instruction in the Natural Sciences has not been adequate in numbers or in preparation. In short, neither the time nor the opportunities have

yet been sufficient for the complete unfolding of the educational value of such branches.

A better understanding of the present position of natural science instruction will be gained, if we trace, though in broad outlines, the history of its introduction into the common school system.

The first decided reaction against the exclusive study of the dead languages took place in England and France as far back as the sixteenth century. It took the form of a stand against the purely humanistic training and the common depreciation of the useful so characteristic of the scholars of those days. A pupil, it was argued, after taking a school course should become better fitted for practical life than was the case under the existing system. It was further urged that there were subjects much nearer the living interests and sympathies of the youth, subjects which had more points in common with real life, than the dead languages. Montaigne was the chief exponent of this view in France. That candid and debonair old writer had some very clear and, for his times, very novel, opinions about educational methods. The estimate he put upon the discipline of the schools of his day was not high. "When the pupil," he said, "comes back from school, all that you shall find he has got, is that his Latin and Greek have made him a greater and more conceited block-head than when he went from home." He further says that education should "form and mould the pupil not only by words and precepts, but chiefly by works and examples." He was the first, perhaps, to make a plea for modern language study, in saying, "I would first understand my own language and that of my neighbors, with whom most of my business and conversation lies." In short, the tendency of his teachings may best be gathered from his dictum: "Instruction should make the pupil better fitted for everyday life."

Further, realistic tendencies, as far as they existed about the beginning of the seventeenth century, received a great impulse, especially in England, from the empirical philosophy of Bacon. That great thinker saw the true end of knowledge and education in the production of useful results, that should contribute to the material as well as to the moral and intellectual improvement of mankind. Such teachings had, apparently, no immediate effect. But a demand soon arose for a contraction

of the sphere of the dead languages and for an extension of that of the study of Nature. The philosopher Locke was also a prominent advocate of this innovation. With characteristic modesty he confesses himself contented with being "employed as an under-laborer in clearing ground a little, and removing some of the rubbish that lies in the way to knowledge." There was little doubt concerning what, in his opinion, constituted the rubbish. On the Continent again, Germany was not to be found lagging behind in the general movement towards the real and natural in education. There, too, a party made itself felt, asking that subjects of a more realistic nature be taught in the schools, and pointing out that the exercise of the observing faculties should go hand in hand with a study of words. The great Comenius declared that, "Men must be induced to learn not out of books, but by observing the heavens, the Earth, oaks, beeches, etc., that is, they must study the things themselves, not simply the accounts of others concerning them." He further says, "Let nothing be taught except for manifest use"; and again, "Knowledge of things close by us should be acquired first, then of those farthest off. There is nothing in the mind, that has not previously been in the senses." Later on, these general principles of pedagogy were further expanded by Rousseau, who was among the first to recognize in nature studies an important means of developing the powers of the mind. He says, "As the senses are the first faculties to develop, so we should strive to perfect them first." The interest, moreover, which such men as Goethe and von Humboldt took in the study of Nature, and their high estimation of its educational value, had great influence in arresting the attention of educators.

Though the example and teachings of such leaders of thought had great weight, there was another factor of even greater importance—the views and wishes of the general public, or at least of the general thinking and progressive public. About the beginning of the present century people began to recognize that the great material improvements of modern times were due to the development of the Natural Sciences. They believed that it was "not by philosophical, but by material, research that a great part of mankind had been brought to a higher plane of living." They acknowledged that it was by mate-

rial research alone that mankind had been freed from the intolerance and superstition of the past. They clearly saw that the great discoveries of modern times, which had brought with them so much of good, had been effected through the study, not of the dead languages, but of Nature and of the operations of its forces. Hence the Natural Sciences began to be looked upon as the basis of the strength of a state, and some study of them in the schools was demanded as necessary to the public good. This movement for reform was aided by the meetings of scientific societies and congresses, both national and international, having as their aim the progress and spread of the Sciences and the increase of their applications. On such occasions it was strongly urged that for the further development of the Sciences and for their application in the widest sense, more attention must be paid to them in education.

We are not to conclude, however, that this wide-spread desire for an enlargement of the educational fundament at once brought about any considerable modification of the school system. This would have been impossible for practical reasons alone; for, as pointed out above, properly equipped teachers and suitable methods for giving instruction in the Natural Sciences were wanting. There were, besides, particularly among pedagogues, violent opponents of the new doctrine. Progress was, therefore, slow and painful. The roots of the old established system had penetrated too deep and wide into the life and thought of men to be easily loosened. Prejudices of long standing are always difficult to overcome, and the one great prejudice here was that no subject under Heaven could be found better adapted to develop all the mental faculties than Latin and Greek. These had been the chosen instruments of each one's own intellectual training. What more could the new-fangled Sciences offer? One writer says, well reflecting the sentiments of the earlier decades of the present century, and possibly, to some extent at least, even of the present day, "The advancing school of realism seeks to pour over the soil of solid, honest culture all kinds of filthy water drawn from the sources of everyday life. They fancy this will fertilize that soil, but in reality it will diminish, if not forever destroy, its fertility." Much has been written in the same vein, protesting against the admission of the Natural Sciences to

anything like an equality with the dead languages and humanistic studies. We sometimes find passages that amuse, rather than call for serious comment or thought. Witness the following fervid and somewhat quaint outpouring: "How can the pupil form steady habits of labor and thought, if he vibrates day after day between the widest extremes—from the golden sayings of Pythagoras to the breeds of lizards, crocodiles, toads and snakes—from the laws of Solon and Lycurgus to baobabs, quartzrocks and pebbles, or to the maki and orang outang—from the dying words of Socrates to the seals, walruses and polar bears of the Esquimaux—in short, from the conceptions of reason to unreason, from the ideals of mankind to the beasts, from the sublime and immutable to the changeable, common and worthless, which gain significance only through the conceptions of reason."

In the foregoing passage, however fanciful and exaggerated, one may clearly see an expression of the spirit that, ignoring the disciplinary value, and depreciating the material worth of the results, of Science study, would magnify out of all due proportion the importance of the results of antique thought and philosophy for our present educational purposes. It is that same spirit that would, without hesitation, arrest the whole material progress of mankind, rather than have one single cherished ideal exposed to the "solvent action of natural knowledge." It is that same spirit that would make the shores of the Mediterranean the limit beyond which human thought should never be permitted to stray. It is that same spirit that would place the human mind in eternal bondage to Latin and Greek idealism. Ten centuries of servitude are not sufficient: the articles of indenture must be made binding *in perpetuum*.

Now, it is well agreed on all hands that the civilization of Greece and Rome preceded and conditioned the highest civilization of the present day in the same manner that infancy precedes and conditions childhood, or that childhood precedes and conditions manhood; so that if we wish to gain a true knowledge of our own civilization, we must study its "embryology" in the life of the Greeks and Romans. True enough, but can not the substance of this knowledge—which is the essential thing aimed at—be acquired, without bringing its shell and framing into

such undue prominence? Time was, when more importance was attached to the casing than to its contents. That position has now been largely abandoned and a retreat has been made within the more defensible embryological stronghold. This change of base was rendered necessary as soon as the modern languages became active competitors of the classics as means of linguistic discipline. No one wishes to repudiate the debt of gratitude which we owe to the art, science and literature of Greece and Rome. No one denies that a study of ancient culture is calculated to make us better acquainted with human aims, human motives, in short, with human nature. But, as Rosenkranz so well remarks, "the danger of humanism is that it makes the means into an end, and does not provide for a return out of the Latin and Greek world to the modern world." That the greatest scholars affirm that the Greek language is the most graceful and perfect means of expressing human thought, is no less true than that, at a large estimate, only one individual in every ten thousand of population will probably ever be able to appreciate that discovery. It is certain that the ordinary college graduate, who, though he may have spent as much as four years in the humanizing society of the classics, only with the aid of lexicon, notes and "ponies" can painfully extract the sense of his Horace or Euripides, alone and unaided would never divine that superlative excellence. That the nomenclature and terminology of most—not all—of the arts and sciences are based upon the Latin and Greek, is no less true than that one might gain a working key to the whole in six weeks' diligent study. To sum up, then, the benefit to be derived, in the case of the average student, from an extended course in Latin and Greek is not at all commensurate with the tremendous outlay of time and labor required, particularly in view of the attention so urgently claimed for many other subjects of real living interest and importance.

In considering the position which nature study ought to occupy in the general education of the youth, we are confronted with a number of questions that have to be answered. Wherein lies the essential difference between instruction in Natural Science and in other branches, most notably the dead languages? In what particulars has the former an advantage over the latter?

We answer, in the first place, in the more thorough training of the pupil's mind in the methods of inductive reasoning. This special feature and all other special disciplinary features of nature instruction have been disclosed only slowly and gradually, because the attention of men was first directed to a study of the Natural Sciences more from practical considerations than from an appreciation of their valuable educational elements. They were first taught because of the real application that could be made of them in the arts, industries or learned professions. Though this is still an element of strength, it is now only of secondary moment in teaching the Sciences to the youth. The leading object is to train the pupil for independent thought and action, and above all to guide him into those channels of moral acting and thinking, where he will become what we call a good citizen.

Let us first consider the training of the intellect by nature instruction. It is confidently asserted by those who have had an opportunity of seeing the matter tested, that there is no better means for quickening the intellectual life and for developing the faculties of the youthful mind, particularly the powers of observation, expression and inductive reasoning, than by exercising it upon the facts and phenomena of Nature. By this means the dormant energies of the pupil are best awakened, and by this means he is best led to think for himself. It seems, in fact, to be the natural order of introducing mental food, to proceed from what is near the pupil to what is further removed from him, from the simple to the complex, from the known to the unknown. "Any right system of education," says Dr. Carpenter, "takes up the faculties in the order of their development, and it is certain that the observing faculties are developed before the reasoning; therefore the training of the observing faculties should precede by attention to the phenomena of nature." Proper instruction in the Natural Sciences provides in a graduated, systematic manner for this "attention to the phenomena of Nature," and it is perfectly clear that this is the proper order of presentation, as it corresponds more nearly to natural conditions than does a study of abstract subjects. "The great peculiarity," says Huxley, "of scientific training, that in virtue of which it can not be replaced by any other discipline, whatsoever, is this bring-

ing of the mind directly into contact with fact and practising the intellect in the completest form of induction." By a training exclusively humanistic and classical, the mind is exercised chiefly upon imaginary premises, while in a study of the Natural Sciences, the premises are the real living facts of Nature, that must of necessity appeal more strongly to the mind, and especially to the youthful mind. They must perforce arouse a deeper, more lively interest, on account of the direct contact into which the mind is brought with them. It would, therefore, seem probable that an exclusive pursuit of abstract studies, exclusive practise in deductive reasoning, must result in laming the inventive faculty, must diminish the power of taking the initiative in any business or enterprise of life. Whewell says that "the operations of the rational faculties, if allowed to go on without a constant reference to external things, can only lead to empty abstraction and barren ingenuity." The same philosophic thinker further explains: "It seems to me that our study of the mode of discovering truth ought to be based upon a survey of the truths that have been discovered."

The next question that arises is, why do we particularly need to cultivate inductive habits of thought, inductive methods of reasoning? And here again we answer, because in the affairs of everyday life, the mind must consider just the same kind of facts and must reach the same kind of conclusions as in the pursuit of natural knowledge. In other words, in regulating our ordinary affairs we have more often to employ inductive than deductive methods of reasoning, since, from a number of observed facts, we have to draw some general conclusion; since from sundry data we have to rise from uncertainty to some decision. That the exclusive study of the classics and humanities does not train the powers of observation or inductive reasoning, is perfectly clear to any one, who has ever given instruction in Natural Science to pupils, whose faculties have been practised solely in those branches, which involve chiefly deductive methods. Hence the necessity for supplementing classical training by discipline in scientific methods of work and thought. The defects of our present system of instruction are by many largely attributed to the ignoring of this principle.

To convince us that our present system

has defects—and grave ones, too—the most superficial observation is entirely adequate. How else can we account for the fact that a certificated and diplomaed graduate does not necessarily carry off the prize from his less favored uneducated competitor? Henry Clews, the well-known New York banker and man of affairs, is reported to have publicly stated that he would not give employment to a college graduate. In holding such an opinion of the finished product of higher education, Mr. Clews by no means stands alone. Numerous other competent judges, of wide and ripe experience in human affairs, are of substantially the same mind. What a sad commentary upon the educational methods in vogue! It may well give us pause, when a young man, who is stamped and marked as liberally educated, in seeking employment should be confronted with the placard—"No college graduate need apply." What is there in our system, that, in place of fitting a youth for the work of life, throws at the very outset a stumbling block in the way of his advancement? What are the qualities of our youth's alleged education that militate against his success? We answer—to use plain language—it is because his training has been too theoretical, because it has dealt too largely with the abstract, instead of with the real, useful and practical. Upon investigating his case, we would probably discover that some of the most precious years of his apprenticeship to our system had been spent in pursuit of material, that could not at all be made available for his future building. We would probably find that his training had been based upon educational theories and not upon natural conditions. We would probably find that the study of the dead languages had figured prominently as the ways and means of his discipline, while but an insignificant rôle had been appointed to those branches that teach us our true relation to external nature and to human society. From whatever sources, in fine, the deficiencies arise, no one can deny that the present system of education comes far short of accomplishing its mission; and he who shall point out the remedy and cause it to be applied, will confer an inestimable benefit upon his race. He who shall show us how to make education more real and not solely ornamental, as are those tall and graceful bottles we see in pharmacists' windows filled with bright colored liquids,

beautiful in color but possessing no healing virtue, will deserve our undying gratitude. He may feel assured of a niche in the pedagogical Walhalla, where rest enthroned the mighty spirits of dead heroes—Comenius, Pestalozzi, Froebel, Huxley—

“The dead but sceptered sovereigns,
Who still rule our spirits from their urns.”

In discussing the merits of the two great divisions of human knowledge—the humanistic and classical and the scientific—for purposes of instruction in the schools, the comparative value of the positive knowledge to be gained has always, and rightly too, played a prominent, though not the chief rôle. The moral and intellectual discipline has been properly considered of paramount importance. But since the faculties of the mind can not be trained without using some branch of knowledge as the means, the acquirement of some information, of some body of knowledge, is unavoidable. Now, upon comparing the value of a knowledge of the dead languages with the value of scientific information for the great majority of pupils, it will hardly be found that the advantage lies upon the side of the former. It will scarcely be argued that a knowledge of Latin and Greek can be of much service in most lines of business or trade; in only a few of the learned professions, indeed, will it be of considerable import. The day is now long passed since Latin—and still longer since Greek—was the common language of Science and Philosophy throughout the civilized world. Although the terminology of many departments of human knowledge abounds in Latin and Greek prefixes, suffixes and roots, yet is it easy for one who could not construe a single line of Caesar or Xenophon, to gain a complete understanding of the significance of the terms. To require a lawyer or a physician, for example, to learn Latin so that he might understand the meaning of the Latin words and phrases, that occur in his professional literature, would be but little more reasonable than to expect a musician to learn the Italian language so that he might comprehend the meaning of *piano*, *forte*, *andante* and other Italian words that appear upon music scores. In this connection a modern French writer on educational subjects suggests the propriety of restoring the Latin language to its former position as “the language of the learned,” particularly as the medium for

scientific communications. While not denying the possibility of such a renaissance, we may fairly doubt its probability. Some one has suggested that the only hope of succeeding in such an enterprise lies in the possibility of applying to the solution of the problem, the well-known physical principle, according to which, different forms of energy are interconvertible. If the heat of classical champions could be converted into electrical energy, the latter might suffice to galvanize the ancient Latin corpse into making some kind of spasmodic movements bearing a remote resemblance to those of a living body. The distinguished Frenchman has evidently forgotten that “the mill will never grind with the water that has passed.”

Turning our attention, on the other hand, to the value of natural knowledge, it would be difficult to mention an occupation in which its possession would not be of direct and positive value. The pursuit of such knowledge has led to all the marvelous inventions and discoveries, to the great progress in commerce and industry, of modern times. “Scientific thought,” says Kingdon Clifford, “is not an accompaniment or condition of human progress, but human progress itself.” Every branch of manufacture, every kind of human industry, rests upon scientific knowledge and is carried on according to scientific principles. Empirical knowledge and “rules of thumb” no longer suffice for success; and he who neglects the indications of scientific investigation in the prosecution of his business or profession will inevitably be left behind in the race of life. Huxley warns us that “in an age of artillery, we can not continue to send our boys into battle armed with the sword and shield of a gladiator.” In the work of life, we have to deal with the facts and forces of Nature, if we would escape being ground to dust; and in direct proportion as we recognize its laws and make our actions conform thereto, will we be likely to succeed.

Instruction in Natural Science, in addition to its value for intellectual training and for utilitarian purposes, has, further, a moral element of prime worth. It is generally acknowledged that all instruction, of whatever character, should tend towards and have as its final object the promotion of morals; that it should make the pupil an active, thinking, upright member of society; that it should awaken a lasting and a broad interest in, and a many-sided

sympathy with, Nature as well as with human life. The advocates of Science teaching believe that a study of Nature will best accomplish this; they believe with the poet that,

"One impulse from a vernal wood
May teach you more of man,
Of moral evil and of good,
Than all the sages can."

—*Wordsworth.*

Now, it is claimed on the part of those who favor humanistic studies, that they lead a pupil to an understanding of human things and to a sympathy with men. But, as so often remarked, we can not properly study man apart from his surroundings in nature. We need, then, to supplement the humanities by using means that will accomplish the same thing for man with reference to external nature, that the humanities do for him with reference to man. The mission, in short, of Natural Science instruction in this respect, is to bring man to a sound knowledge of his true position in nature. The pupil must be brought to recognize the earnestness of the teachings of nature. "The laws of Nature," says Oersted, "are the thoughts of God." "A physical fact is as sacred as a moral principle. Our own nature demands from us this double allegiance," remarks Agassiz. This high ethical value of science instruction springs from the fact that the Natural Sciences are founded on truth, as well as the human intellect can comprehend it, and promote it as no other branch can. All moral acting and thinking, that have any rational foundation, must be based upon a recognition of man's true position in nature. Our conceptions, therefore, of what is right and of what is wrong will approximate the truth in direct proportion to the correctness of our knowledge of nature's plan with reference to man. When nature studies are properly taught, the pupil always finds therein new sources for energetic effort of thought, and a sound criterion and basis for applying thought to other sets of circumstances in life, as regards not only the phenomena of nature but also of social and political life. "There is one moral benefit which the pursuit of science unquestionably bestows. It keeps the estimate of the value of evidence up to the proper mark. We are constantly receiving lessons—and sometimes very sharp ones, too—on the nature of proof."

The function of science teaching is to develop all the faculties of the mind that are at all required for a study of Nature; to inspire with a sympathy for whatever has been found out by such study; and to bring man into harmonious relation with all external creation. But this is not all. It is also capable of striking those chords that bind man to man and of making them vibrate in unison. To show its humanizing influence, its efficacy in shaping the motives and purposes of its votaries, we might quote the words of one of its greatest apostles concerning his own aim in life: "To promote the increase of natural knowledge, and to forward the application of scientific methods of investigation to all the problems of life to the best of my ability, in the conviction, which has grown with my growth and strengthened with my strength, that there is no alleviation for the sufferings of mankind except veracity of thought and of action, and the resolute facing of the world as it is when the garment of make-believe, by which pious hands have hidden its uglier features, is stripped off." Here we find the expression of an ideal that will compare favorably with some of more ancient lineage. The goal of the greatest investigators of nature has ever been of an unselfish character—the attainment of truth for its own sake and for the sake of what it could do for their fellow-men. They have ever believed that the truth, and the truth alone, could make the human race free, free from physical suffering no less than from moral deformity. Animated with this hope they have labored without rest and without reward, reflecting nothing but honor upon their race, while the fruits of their labors have fallen upon their fellow-men like a gentle rain from Heaven, always blessing never harming. "The history of empire is that of the misery of men; the history of the sciences is that of their grandeur and happiness."

We hold, then, that the Natural Sciences when properly taught exercise the mental faculties of pupils, training them in accurate observation, correct expression and sound reasoning; that they give valuable information, which can be made available for the purposes of ordinary life; and, further, that they mould the pupil's moral nature, giving an earnestness and arousing an energizing, vitalizing interest in the affairs of life, which must have a steady and preserving action upon the character

amidst the vicissitudes and disturbing elements of our earthly existence. They must gradually attain to that position in educational matters, which corresponds to the influence they have had and still exercise upon the general welfare of mankind. As Bacon says, "they will teach us to think how to live, instead of living only to think; and not to inflate plain things into marvels, but to reduce marvels to plain things." We can not believe that through either prejudice or ignorance the present assessment of educational values will long hold good. No valid reason can be brought forward why less time should be devoted to nature studies than to other branches. And we may safely say that the time will come when dead educational timber of every description—classical as well as other kinds—will be lopped off and cast into the oven; when moribund trees of knowledge, that have long since ceased to bear good fruit, will be hewn down to make room for living stocks; when the traditional and partly fictitious lustre of the classics will grow pale as the Sun of Science rises; and when a knowledge of the living truths of nature will become the common property of mankind. But from the very nature of the problem, progress in this direction will, and must, be slow. The methods of giving nature instruction must first be improved and adapted to existing conditions. As soon as this is accomplished the Sciences will, in an easy and unconstrained manner, enter the very lowest grades of the school and continue their incomparable missionary work of naturalizing, civilizing and humanizing the race. Their salutary influence will then be felt throughout the mass of mankind. We need not cherish the time-honored but utterly senseless fear that the light of Science will show us something we ought not to see.

MR. L. E. ARMSTRONG ('94), is at present principal of the Rawlins, Wyoming, High School, and Mr. Charles Brookover, of the same class, is principal of the Madison, Kansas, public schools. The latter has also been engaged to do some work in the county institutes of his adopted state.

PROFESSOR H. R. Higley ('92), has been teaching during the fall in Warwick, N. Y. In January, '96, he will take his place as a member of the Faculty of one of the Pennsylvania State Normal Schools.

Editorial Notes.

A STUDENT'S RECITAL, was given in the College Chapel, Tuesday, November 12, at 8 o'clock, P. M., with the following programme:

- Overture, "Der Freischuetz," Weber
 MISSES INEZ RIDDILE, GRACE GIST, LULU BROWNE AND
 FLORENCE CRAIG.
 "Night in Spring," Bohm
 MISS BERTHA HOOVER.
 Polka, op. III, ... Spindler
 MISS MAMIE O'BLENESS.
 "I Know a Bank," Horn
 MISSES FLORENCE CRAIG AND KATE CRAWFORD.
 Song to the Evening Star, from Tannhauser, Wagner-Listz
 MISS GRACE REAH.
 "Garden of Sleep," DeLara
 MR. CHARLES O'BLENESS.
 Fantasia in C, ... Schaffer
 MISSES ADA PICKETT AND MARY PICKETT.
 PART II.
 Ladies' Chorus, "Ave Maria," Marchetti
 Ballet music from Feramors, ... Rubenstein
 MISSES INEZ RIDDILE AND ESTELLA HOBSON.
 "Then Would I Die," Tosti
 MISS FANNIE WITMAN.
 a. Nocturne, G Major, ... Chopin
 b. Allegro, Sonate op. 2, No. 2, ... Beethoven
 MISS INEZ RIDDILE.
 "Amore," Pinsuti
 MISSES GRACE GIST AND DOLLY GIST.
 Gondoliera, ... Liszt
 MISS FLORENCE CRAIG.
 "The Last Rose of Summer," Schlehmann
 MESSRS. NEWMAN BENNETT, CLARENCE HENSON, ROY
 CLAYTON AND RALPH SUPER.

It is impracticable to fix a date at this time for the opening of the summer term, '96, but it will probably be the last week in June. It will continue six weeks and the tuition will be five dollars for the entire term, or one dollar per week for less. This will embrace most of the subjects taught in the Preparatory Department, except those that will require the use of the laboratory. For collegiate students the charge will be from five to ten dollars for each branch, in addition to a small fee for material used in the laboratories. Intending students are requested to write to Professor Dunkle, who will furnish definite information. The attendance during '95 was nearly one hundred, and all report themselves thoroughly satisfied with the work done.

The following recital was given by the Department of Elocution, at the City Hall, Monday evening, November 25, 1895, at 8 o'clock :

RECITATIONS.

From, "Tempted by the Devil,"	A. Conan Doyle
Geo. W. Brown.	
"The Cross-roads' Ghost,"	Lippincott's Magazine
Charlotte R. Kaler.	
From, "The Birds' Christmas Carol,"	Kate Douglas Wiggin
Esther H. Burns.	
From, "A Rose of the Mire,"	Kate Jordan
Della M. Connett.	
The School Exhibition,	Original Adaptation
Mabel L. Wickham.	
From, "The Madonna of the Tubs,"	Elizabeth S. Phelps
Maud M. McGrath.	
Athletics for College Men,	Chauncey M. DeFevo
Wm. A. Dailey.	

INTERMISSION.

Drama—"The Ugliest of Seven," From the German

CAST OF CHARACTERS.

Ernest Hellwald,	Chas. O'Brien
Jeremiah Ambrose,	Geo. W. Brown
Ernestine,	Minnie O. Roach
Rosa,	Kate Crawford
Elise,	Esther H. Burns
Gabrielle,	Mabel L. Wickham
Amelia,	Florence M. Craig
Dora,	Pearl Roberts
Adelaide,	Charlotte R. Kaler
Madame Moorpiltz,	Nellie Cobb
Madame Kunkel,	Lena Hatfield
Madame Mousetooth,	Della M. Connett
Peasants,	

ONE of our sister institutions is sending out the following announcement :

"This college now affords its students advantages in rhetoric which few other colleges offer. Personal consultation is held with every Freshman and Sophomore upon every essay written. An essay is required each week from every man in each of these classes. Each essay receives careful written criticism from the instructor. This criticism consists in the correction of all faults in grammar, spelling, punctuation, sentence structure and paragraphing, and in addition a carefully formulated general criticism on the entire essay, indicating what faults are most prominent, and what the student should do to amend these faults. The instructor then goes over the essay in private with the student, points out to him where he is strong and where he is weak, and advises him what methods he should pursue in composition."

This is an excellent way of teaching rhetoric and composition, as we can testify, for we have been pursuing it for several years. We are glad of the opportunity of endorsing it. We do not require

an essay every week, but we continue our instruction as long as the pupil needs it, which is not unfrequently to the end of his course. We are glad to see other colleges doing as we have been doing, for this is the only way, as our teachers have found by a careful study of the problem, of making the study of English composition profitable. We have been of the opinion for some time that one of our shortcomings is our modesty in proclaiming our merit.

Now and then one comes across a college graduate who finds fault with his *alma mater* for his lack of success in life. It can not be too often repeated that the mere possession of knowledge is no guaranty of prosperity. It is indeed the key to success, but nothing more. He who depends solely upon an education to secure position for him is almost sure to be disappointed. Some of the greatest scholars have been failures because they did not know how to make use of their intellectual attainments. The chief element of success is the willingness to meet the conditions upon which it depends. The world has need of efficient young men and women, but it is not willing to accept them at their own estimate of themselves. There is no danger that our young people will get too much education; there is danger that they will depend too much on mere knowledge where other qualities and attainments are equally important.

It is expected that an additional teacher of music will be added to this department in the University. It has become evident that an instructor for wind and stringed instruments would have plenty of pupils.

THOS. L. YOUNG (B. S. '95), has been appointed to a responsible position in connection with the electric light plant at East Liverpool, Ohio. Mr. Young is well qualified intellectually for such a place and when he takes hold he does so with the determination to succeed.

Personal Notes.

PROFESSOR Boughton is one of the trustees of the Beta Theta Pi fraternity.

I. M. FOSTER (B. Ph. '95), is at present a student in the Harvard Law School.

MR. E. E. BAKER ('94), is now superintendent of the Mount Sterling Schools.

MR. C. J. LANE, of the same class, is in the employ of the Edison Company at Cincinnati.

W. P. COLLIER (B. A. '95), has returned to his *alma mater* and is doing post-graduate work in Greek.

MR. H. H. FULLER ('78), died at Athens, Ohio, where he was temporarily residing, on the 18th of October.

THERE will be six local contestants from whom is to be selected the representative of the college at the state contest.

THE Rev. Dr. Iliff ('70), was elected Chaplain-in-Chief at the recent encampment of the G. A. R. in Louisville.

THE widely known Dr. S. A. Keene, who died recently at Delaware, received the degree of D. D. from the O. U. in 1886.

MR. F. M. McADAMS, who holds a certificate from the Electrical Department, is in charge of the Light and Power Plant at the Reform Farm.

PROFESSOR Atkinson's article, "Opportunities in Electrical Engineering," that first appeared in *Electricity*, has been copied in several scientific periodicals.

PROFESSOR John A. Shott ('92), of Carthage, Ill., has a well written article in the November number of *Education* entitled, "Ethical Tendencies of Science Study."

THE students of the class in electrical engineering have formed themselves into an Electrical Society and have elected A. L. Kindt, President, and E. J. Chute, Secretary.

PROFESSOR Gordy was engaged in doing institute work in several counties of Pennsylvania during the fall term. He has more calls of a similar nature than he can accept. The first volume of his "History of Political Parties in the United States" has been adopted by the Ohio Teachers' Reading Circle, and is meeting with a ready sale elsewhere.

PROFESSOR Evans was recently elected president of the S. E. O. Teachers' Association for the coming year. This association is composed of the following counties: Athens, Gallia, Hocking, Meigs, Perry, Vinton and Washington.

PRESIDENT Super was one of the honorary pall-bearers at the funeral of the late H. S. Bundy. It is not yet known when the Governor will appoint his successor in the trusteeship. Of the seventeen members now serving on the Board eleven are alumni or former students of O. U.

HON. H. S. BUNDY died at Wellston on the 12th of December. He had been a trustee of the O. U. since 1864. For more than fifty years he was one of the prominent men of the state. Though deprived of almost all educational opportunities in early life, he in time acquired a large fund of information of a practical kind. He took a deep interest in education, and was never absent from a meeting of the Board except when unavoidably detained. He enjoyed the esteem alike of rich and poor, old and young. At the time of his death he was in his seventy-ninth year.

Book Notices.

From Ginn & Co. we have received Frye's Complete Geography.

This is a volume of some 200 pages, beautifully illustrated with excellent wood cuts, maps and charts. Unlike many manuals of Geography, it begins with the earth as the abode of man, and not with the earth in space. A good deal of attention is given, very wisely, we think, to matters usually relegated to the domain of physical geography. The permanent features of the earth's surface are most fully set forth, while the political divisions receive less attention. We have rarely seen a book on the subject of which this treats that has, on the whole, impressed us so favorably.

From the American Book Company we have to acknowledge the receipt of Latin Lessons, by E. W. Coy.

Traumerei an franzoesischen Kaminen, Herr Omnia, and several volumes of Eclectic School Readings.

These readings are intended for pupils of the first, second, and third reader grade, and are well adapted to their intended purpose. The style is excellent, the matter interesting and profitable, both from the ethical and historical standpoint. The make-up of the volumes is fully abreast of the high standard of excellence which characterizes the publications of the Company. Lack of space forbids a fuller notice in this issue of the BULLETIN.

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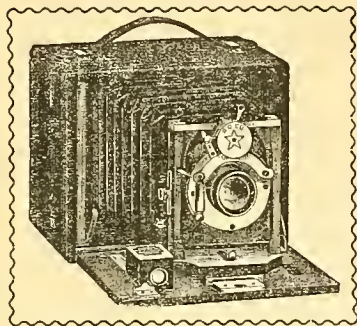
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